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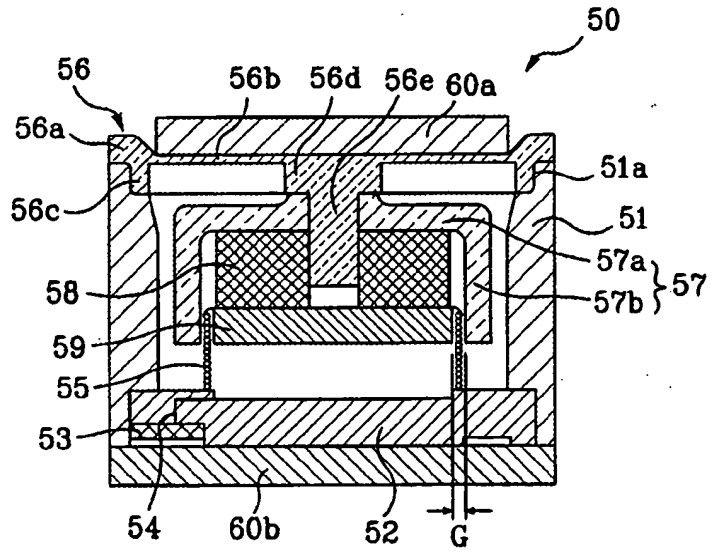
(54) Title: BONE CONDUCTION VIBRATOR



(57) Abstract: A bone conduction vibrator which can increase an output efficiency and achieve a wide-band frequency is disclosed. The bone conduction vibrator comprises a frame which is formed in a cylindrical shape and has opened upper and lower ends; a base plate which is fixed into the opened lower end of the frame; an amateur which includes an annular rim having a certain thickness and fixed into the opened upper end of the frame and a circular vibrating plate coupled to an inner circumference of the rim in a state of stepped down to a certain depth, and for controling a frequency band according to a diameter, thickness and material of the vibrating plate; a yoke which includes a circular body portion for supporting the amateur and an extended portion extended downwardly integrally along the outer circumference of the body portion, and for concentrating magnetic flux; a magnet which is mounted inside the extended portion of the yoke and an upper surface of which contacts integrally with a lower surface of the body portion of the yoke; an upper plate which is mounted inside the extended portion of the yoke, an upper surface of which contacts integrally with a lower surface of the magnet, and for forming a magnetic circuit with the magnet and the yoke; and a voice coil which is located in a gap between an outer circumference of the upper plate and an inner circumference of the extended portion of the yoke, and a lower end of which is mounted fixedly on the base plate. Further, circular plate-shaped cushion members adhere to an upper surface of the vibrating plate of the amateur and a lower surface of the base plate, respectively.a

WO 02/19759 A1

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BONE CONDUCTION VIBRATOR

TECHNICAL FIELD

The present invention relates to a bone conduction vibrator, and more particularly, to a bone conduction vibrator in which a frequency band is widened and output efficiency is enhanced while its structure is simplified.

BACKGROUND ART

Generally, a sound which a person hears is a wave generated by a vibration of a substance. A person can hear a sound from speakers of audio equipment, etc., because a person's eardrum vibrates according to the soundwaves in the air.

The soundwaves pass through the person's external ear, vibrate the eardrum, and are transmitted to the brain by cells of the internal ear being stimulated. The general range of sound which the person can hear is from 20 to 20,000Hz, and that of the person's voice is from 500 to 2,000Hz. There are a lot of people who have difficulty in hearing a sound within the above range.

However, telephones, headphones and the like having a bone conduction vibrator, which enable the hearing impaired having disorders of the external and/or middle ear to perceive sound signals by vibrating bones around the ear, have been developed recently. Also, normal persons can perceive sound signals by using bone conduction hearing as well as air conduction hearing.

Based on the above feature of the bone conduction telephones and headphones, these audio listening devices

can be applied to helmets which are used in a noisy site of construction, a market or during a state of emergency like extinguishing a fire.

FIG. 1 is a sectional view of a conventional bone conduction vibrator.

As shown in FIG. 1, the conventional bone conduction vibrator 10 includes a cylindrical frame 11 and a base plate 12 which covers an opened bottom end of the frame 11.

A circular plate-shaped protector 13 is mounted at the top of the frame 11, and a vibrating part 14 which transmits the vibration to a user's body, e.g. a head, protrudes outside through an opening formed at the center portion of the protector 13. A mastoid portion 15 which contacts directly the user's head is formed at the top of the vibrating part 14.

A damper 16 for reducing the amplitude of vibration is provided between the top end of the frame 11 and the protector 13. The vibrating part 14 passes through the center portion of the damper 16.

Under the damper 16, a yoke 17 for concentrating a magnetic flux is provided. The yoke 17 includes a body 17a which supports the center portion of the damper 16 and an extended part 17b which is integrally formed downward along the periphery of the body 17a. The vibrating part 14 is fitted tightly through the center portion of the body 17a of the yoke 17.

A magnet 18 is mounted within the extended part 17b of the yoke 17 while contacting the bottom surface of the body 17a. An upper plate 19 for forming a magnetic circuit together with the magnet 18 and the yoke 17 is mounted under the magnet 18. The yoke 17, the magnet 18

and the upper plate 19 are bonded in contact with each other.

A voice coil 20, a bottom of which is fixed onto the base plate 12, is located in a gap A formed between the upper plate 19 and the extended part 17b of the yoke 17.

The operation of the conventional bone conduction vibrator 10 will now be described hereinafter.

When an electric current is applied to the voice coil 20 from an external power supply(not shown), a magnetic field is generated between the voice coil 20 and the magnetic circuit which is formed by the upper plate 19, the magnet 18 and the yoke 17. In the state of the voice coil 20 being fixed, as the direction of the current flowing along the voice coil 20 is converted over and over again, the upper plate 19, the magnet 18 and the yoke 17 vibrate up and down according to Fleming's left-hand rule.

In the meantime, the vibration of the above magnetic circuit is limited to a certain extent by the damper 16 mounted on the yoke 17. Such a vibration is transmitted to a user's head via the mastoid portion 15 of the vibrating part 14, to thereby enable the user to perceive sound signals by using bone conduction hearing.

An illustrative headphone using bone conduction hearing is disclosed in U.S. Patent No. 5,323,468(issued June, 1994, Bottesch)

However, in order to apply the above-described conventional bone conduction vibrator to telephones, headphones and the like, the output efficiency must be enhanced and the frequency band be widened while simplifying the structure of the vibrator. But, it is difficult to satisfy this requirement. In other words,

the sizes of the magnet and the yoke become necessarily large to enhance the output efficiency. This causes the enlargement of the overall size of the bone conduction vibrator. To the contrary, when making the vibrator small, the output efficiency is reduced. Therefore, it is very difficult to achieve the optimum conditions of the conventional bone conduction vibrator.

Another problem comes from the fact that the details of the communication leak out due to the structure of the conventional vibrator.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a bone conduction vibrator in which a frequency band is widened and output efficiency is enhanced while its structure is simplified.

In order to achieve the above object, the present invention provides a bone conduction vibrator, comprising a frame which is formed in a hollow cylindrical shape having opened top and bottom ends; a base plate which is fitted into the opened bottom end of the frame; an armature which is fitted into the opened top end of the frame and includes a rim portion and a diaphragm integrally formed with the rim portion while being stepped down along the inner periphery of the rim portion, the armature regulating a frequency band according to the size, thickness and material of the diaphragm; a yoke for concentrating a magnetic flux, which includes a body for supporting the armature and an extended part integrally formed downward along the periphery of the body; a magnet which is mounted within the extended part of the yoke such that an upper surface of the magnet contacts a lower

surface of the body of the yoke; an upper plate which is mounted within the extended part of the yoke such that an upper surface of the upper plate contacts a lower surface of the magnet, and forms a magnetic circuit together with the magnet and the yoke; and a voice coil which is located in a gap formed between the upper plate and the extended part of the yoke and is adhered onto the base plate.

The armature further includes a large diameter part extended downward from the center of the lower surface of the diaphragm, a small diameter part extended downward coaxially from the large diameter part, and a protrusion formed along the lower peripheral surface of the rim portion.

And, the frame is formed with a seat along the upper inner peripheral surface of the frame, on which the protrusion is seated.

A PCB terminal, to which an electric current from an external power source is applied, is attached to a portion of the edge of the base plate, an end of a coil is soldered at the PCB terminal, and the other end of the coil is connected to the bottom of the voice coil. When the electric current is applied to the PCB terminal from the external power source and supplied to the voice coil via the coil, the upper plate, the magnet and the yoke vibrate integrally up and down by the attraction and repulsion of magnetic field formed by the upper plate, the magnet and the yoke, and the vibration is transmitted to a user's body through the diaphragm of the armature or the base plate.

And, cushion members formed in a circular plate shape are bonded to the upper surface of the diaphragm of

the armature and to the lower surface of the base plate, respectively, and contact directly the user's body. The cushion members control the output of the vibrator according to the thickness.

BRIEF DESCRIPTION OF DRAWINGS

This invention will be better understood and its various objects and advantages will be more fully appreciated from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view of a conventional bone conduction vibrator;

FIG. 2 is an exploded perspective view of a bone conduction vibrator according to a preferred embodiment of the present invention; and

FIG. 3 is a sectional view of a bone conduction vibrator according to a preferred embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, this invention will be described in detail with reference to the drawings.

FIGs. 2 and 3 are an exploded perspective view and a sectional view of a bone conduction vibrator according to the present invention, respectively.

As shown in the drawings, a bone-conduction vibrator 50 of the present invention includes a frame 51 which is formed in a hollow cylindrical shape having opened top and bottom ends and defines a side wall of the vibrator 50, and a circular base plate 52 which is fitted into the

opened bottom end of the frame 51.

A PCB(Printed Circuit Board) terminal 53, to which an electric current from an external power source(not shown) is applied, is attached to a portion of the edge of the base plate 52, and an end of a coil 54 is soldered at the PCB terminal 53.

Inside the space formed by the frame 51 and the base plate 52, a hollow cylindrical-shaped voice coil 55 is adhered onto the base plate 52. The coil 54 is extended into the frame 51 by passing through the base plate 52, and such an extended end of the coil 54 is connected to a lower end of the voice coil 55. In this state, when the electric current is applied to the PCB terminal 53 from the external power source and supplied to the voice coil 55 via the coil 54, the voice coil 55 induces a change of a magnetic field from a sound signal electric energy.

An armature 56, including a rim portion 56a and a circular-shaped diaphragm 56b which is integrally formed with the rim portion 56a while being stepped down along the inner periphery of the rim portion 56a, is coupled to the opened top end of the frame 51. A protrusion 56c for coupling the armature 56 to the frame 51 is formed along the lower peripheral surface of the rim portion 56a, and a seat 51a on which the protrusion 56c is seated is formed along the upper inner peripheral surface of the frame 51. The protrusion 56c is glued onto the seat 51a.

And, a cylindrical large diameter part 56d is extended downward from the center of the lower surface of the armature 56, and a cylindrical small diameter part 56e is extended downward coaxially from the large diameter part 56d.

The shape, weight and hardness of the armature 56 determine the frequency band of the bone conduction vibrator 50 of the present invention.

Preferably, the armature 56 is made from an aluminum or a stainless material.

A yoke 57 for concentrating a magnetic flux is provided inside the vibrator 50. The yoke 57 includes a circular body 57a which contacts a stepped portion between the large and small diameter parts 56d and 56e for supporting the armature 56 and an extended part 57b which is integrally formed downward along the periphery of the body 57a. A hole through which the small diameter part 56e of the armature 56 passes is formed at the center of the yoke body 57a, and the extended part 57b is disposed adjacently to the outer surface of the voice coil 55. Preferably, the yoke 57 is made by performing a cutting or forging operation for a pure iron having a low magnetic resistance.

A cylindrical magnet 58 is mounted within the extended part 57b of the yoke 57 such that the upper surface of the magnet 58 contacts the lower surface of the yoke body 57a. The magnet 58 is formed with a thruhole at its center portion into which the small diameter part 56e of the armature 56 is inserted.

Also, an upper plate 59 for forming a magnetic circuit together with the magnet 58 and the yoke 57 is mounted under the magnet 58 while contacting the magnet 58 and being located within the voice coil 55. That is, the voice coil 55 is located in a gap G formed between the upper plate 59 and the extended part 57b of the yoke 57.

The armature 56, yoke 57, magnet 58 and upper plate 59 are bonded together by means of an adhesive agent, etc.

Cushion members 60a and 60b formed in a circular plate shape are bonded to the upper surface of the diaphragm 56b of the armature 56 and to the lower surface of the base plate 52, respectively. The cushion members 60a and 60b are preferably made from materials having a high specific gravity and a good shock-absorbing efficiency. Such cushion members 60a and 60b contact directly a human body, especially a head, and control the vibrating characteristics of the vibrator 50. Specially, the output of the vibrator 50 varies according to the thicknesses of the cushion members 60a and 60b.

The operation and effect of the bone conduction vibrator 50 according to the present invention will now be described hereinafter.

When an electric current is applied to the PCB terminal 53 from an external power source, the electric current is supplied to the voice coil 55 via the coil 54. Then, the voice coil 55 induces a change of a magnetic field from a sound signal electric energy.

That is, when the voice coil 55 is applied with the electric current, a magnetic field is generated at the voice coil 55 which is located in the magnetic circuit formed by the upper plate 59, the magnet 58 and the yoke 57. According to Fleming's left-hand rule, in the state of the voice coil 55 being fixed, the assembly consisting of the upper plate 59, the magnet 58 and the yoke 57 vibrates up and down by the attraction and repulsion of the magnetic field formed by the voice coil 55, the upper plate 59, the magnet 58 and the yoke 57. Such a vibration is transmitted to a user's head through the cushion

member 60a bonded to the diaphragm 56b of the armature 56 or the cushion member 60b bonded to the base plate 52, so that the user can perceive sound signals by using bone conduction hearing.

The frequency characteristic of the inventive bone conduction vibrator 50 will be described hereinafter in comparison with that of the conventional bone conduction vibrator 10(see FIG. 1).

First, in the inventive bone conduction vibrator 50, the vibration generated from the diaphragm 56b of the armature 56 is defined as a forward vibration, and the vibration generated from the base plate 52 is defined as a backward vibration.

Upon comparing the frequency band of the forward vibration with that of the backward vibration under the same conditions, the forward vibration has the frequency band of about 150 to 15,000Hz, and the backward vibration has the frequency band of about 120 to 18,000Hz.

By using the above frequency characteristics, the bone conduction vibrator 50 can be adequately applied to products such that the vibration of the base plate 52 is applied to a product requiring a relatively broad frequency band, while the vibration of the armature 56 is applied to a product requiring a relatively narrow frequency band.

Further, when the conventional vibrator 10 has the same magnetic circuit(that is, the upper plate, the magnet and the yoke) in size and material and has the same voice coil in winding number that the inventive vibrator 50 has, the conventional vibrator 10 has the frequency band of about 260 to 2,000Hz, which is considerably narrower than that of the inventive vibrator

50.

In addition, the maximum output of the above-described backward vibration of the inventive vibrator 50 shows higher than that of the conventional vibrator 10 by about 10dB or more.

On the other hand, the frequency band and the output of the inventive bone conduction vibrator 50 depend upon the armature 56 and the cushion members 60a and 60b. For example, the larger and the thinner the diaphragm 56b of the armature 56 is, the wider the frequency band is, while the smaller and the thicker, then the narrower. Also, the thicker the cushion members 60a and 60b are, the lower the overall output of the vibrator 50 is, because the shock-absorbing efficiency of the cushion members 60a and 60b is enhanced.

Besides such shape modifications, by variously modifying the materials and the hardness of the armature 56 and the cushion members 60a and 60b, the frequency band and the output are controlled adequately for the products to which the inventive bone conduction vibrator 50 is applied.

As described above in detail, the bone conduction vibrator of the present invention has the different frequency characteristics between the vibrations in the forward direction(i.e., the diaphragm of the armature) and the backward direction(i.e., the base plate). Thus, only changing the positions of the forward direction and the backward direction of the vibrator easily satisfies the requirements of the products to which the vibrator is applied.

Also, in comparison with the conventional vibrator, the inventive vibrator has a wider frequency band and

more enhanced output efficiency. With the modifications of the shapes, materials and hardness of the armature and the cushion members, the frequency band and the output are easily adjusted while reducing the overall size of the vibrator.

And, since the armature and the cushion members are substituted for the conventional vibrating part including a mastoid portion, pain due to contact with the mastoid portion is eliminated, and the bone-conductive region of the user's body is easily sought by means of the relatively large cushion members.

In addition, communication security is attained by the cushion members which prevent the sound emission.

While this invention has been particularly shown and described with reference to particular embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be effected therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A bone conduction vibrator, comprising:

a frame which is formed in a hollow cylindrical shape having opened top and bottom ends;

a base plate which is fitted into the opened bottom end of the frame;

an armature which is fitted into the opened top end of the frame and includes a rim portion and a diaphragm integrally formed with the rim portion while being stepped down along the inner periphery of the rim portion, the armature regulating a frequency band according to the size, thickness and material of the diaphragm;

a yoke for concentrating a magnetic flux, which includes a body for supporting the armature and an extended part integrally formed downward along the periphery of the body;

a magnet which is mounted within the extended part of the yoke such that an upper surface of the magnet contacts a lower surface of the body of the yoke;

an upper plate which is mounted within the extended part of the yoke such that an upper surface of the upper plate contacts a lower surface of the magnet, and forms a magnetic circuit together with the magnet and the yoke; and

a voice coil which is located in a gap formed between the upper plate and the extended part of the yoke and is adhered onto the base plate.

2. The bone conduction vibrator as claimed in claim 1, wherein the armature further includes a large diameter part extended downward from the center of the lower

surface of the diaphragm, a small diameter part extended downward coaxially from the large diameter part, and a protrusion formed along the lower peripheral surface of the rim portion, and

the frame is formed with a seat along the upper inner peripheral surface of the frame, on which the protrusion is seated.

3. The bone conduction vibrator as claimed in claim 2, wherein the armature is made from an aluminum material.

4. The bone conduction vibrator as claimed in claim 2, wherein the armature is made from a stainless material.

5. The bone conduction vibrator as claimed in claim 1, wherein a PCB terminal, to which an electric current from an external power source is applied, is attached to a portion of the edge of the base plate, an end of a coil is soldered at the PCB terminal, and the other end of the coil is connected to the bottom of the voice coil,

whereby when the electric current is applied to the PCB terminal from the external power source and supplied to the voice coil via the coil, the upper plate, the magnet and the yoke vibrate integrally up and down by the attraction and repulsion of magnetic field formed by the upper plate, the magnet and the yoke, and the vibration is transmitted to a user's body through the diaphragm of the armature or the base plate.

6. The bone conduction vibrator as claimed in claim 1, wherein cushion members formed in a circular plate shape are bonded to the upper surface of the diaphragm of

the armature and to the lower surface of the base plate, respectively, and contact directly the user's body, the cushion members controlling the output of the vibrator according to the thickness.

FIG.1

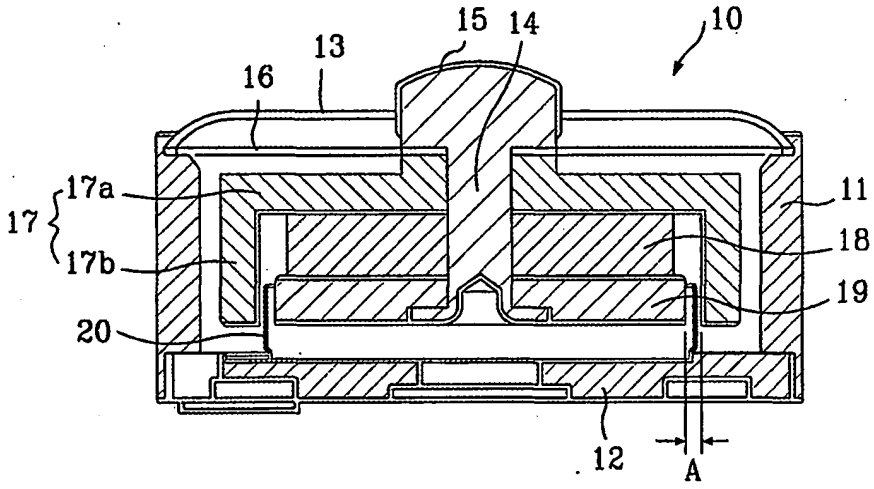


FIG.2

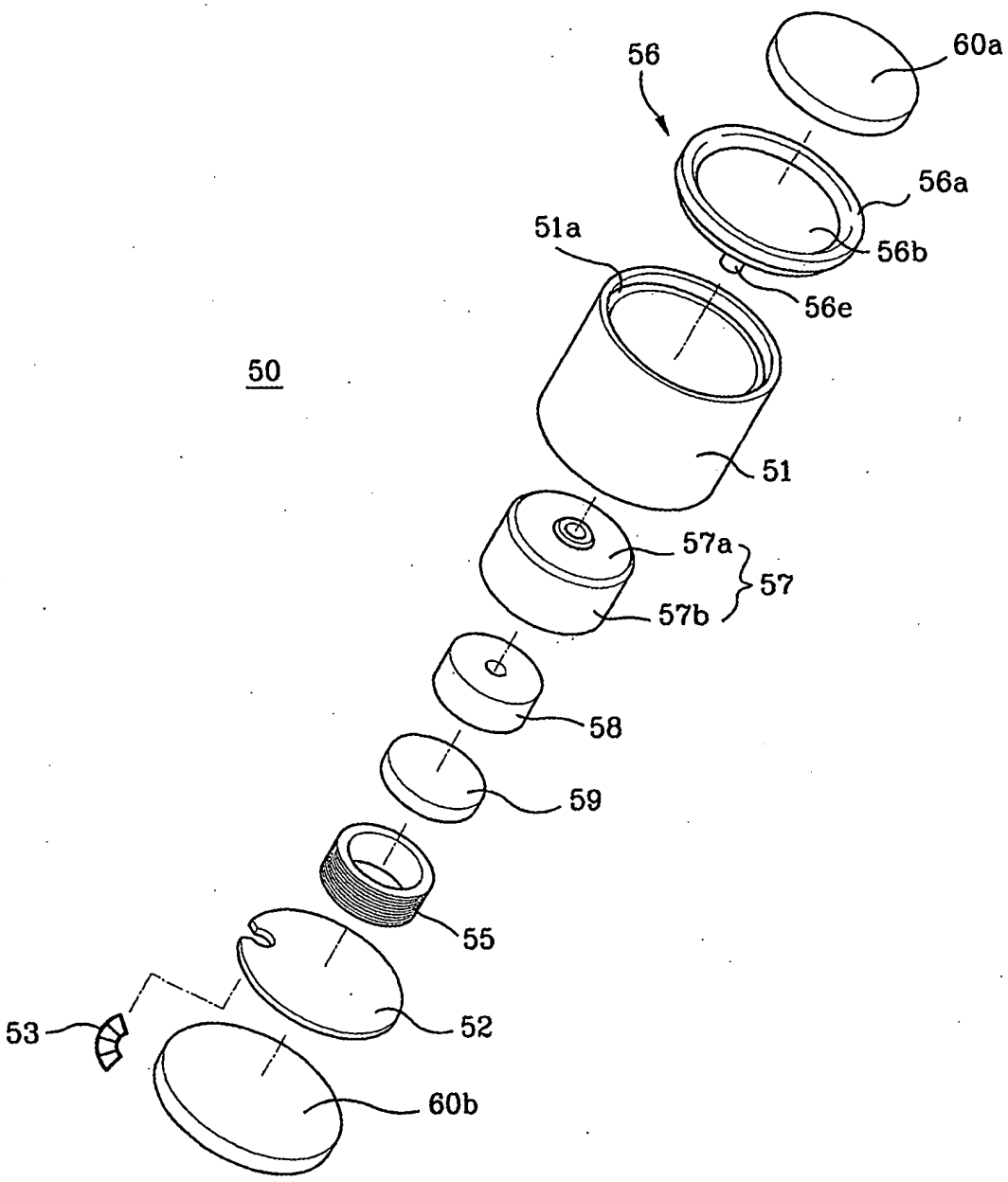
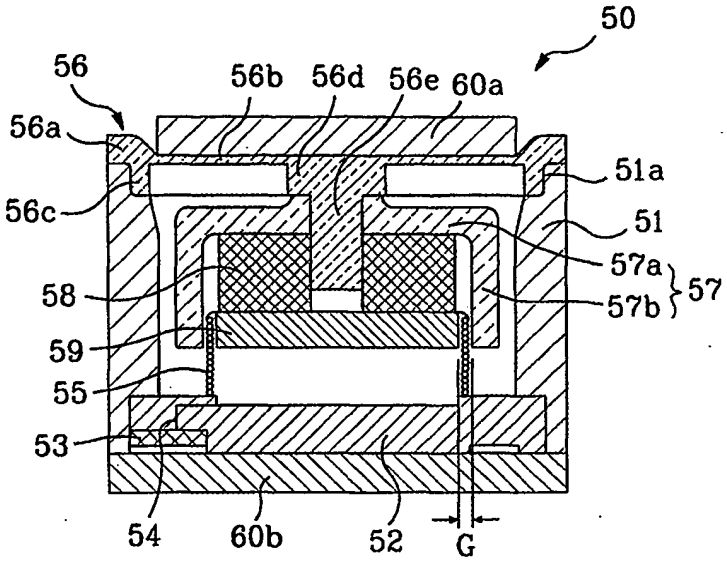


FIG.3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INTERNATIONAL SEARCH REPORT

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PCT/KR00/00991

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04R 1/00, H04R 25/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7 H04R 1/00, H04R 25/00, H04R 9/02

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean Patents and applications for inventions since 1975
Koreans Utility models and applications for Utility models since 1975

Electronic data base consulted during the internationl search (name of data base and, where practicable, search trerms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 99-46111 A (Park, Seung-Gil) 25 June 1999	1, 2, 5
E, X	KR 2001-3562 A (Kim, Shi-Young) 15 January 2001	1, 2, 5
E, X	KR2001-3563 A (Kim, Shi-Young) 15 January 2001	1, 2, 5

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
28 MAY 2001 (28.05.2001)	31 MAY 2001 (31.05.2001)

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